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(71) Applicant(s)

**Sumitomo Rubber Industries Limited**

**(Incorporated in Japan)**

**6-9 Wakinohama-Cho 3-Chome, Chuo-Ku, Kobe-Shi,  
Hyogo-Ken, Japan**

(72) Inventor(s)

**Takeshi Asakura**

**Keiji Moriyama**

(74) Agent and/or Address for Service

**Boulton Wade Tennant**

**27 Fumival Street, LONDON, EC4A 1PQ,  
United Kingdom**

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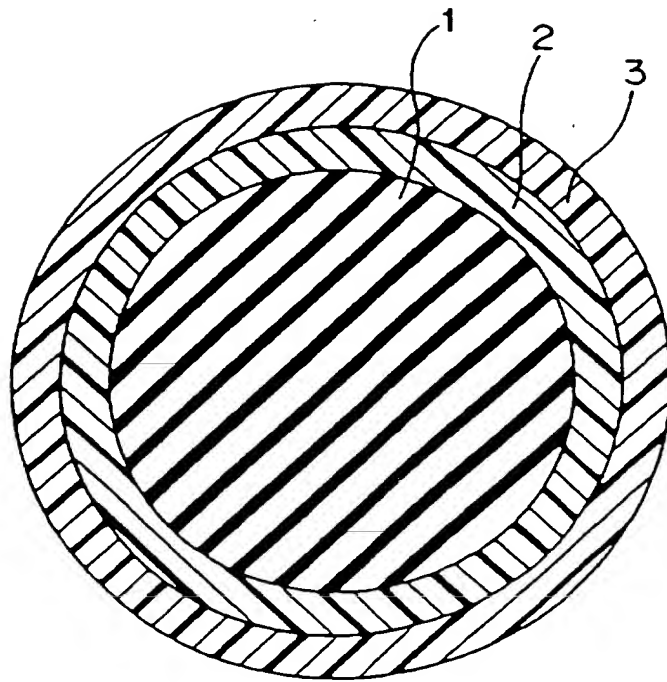
(54) **Solid golf ball**

(57) A solid golf ball comprises a core and a two-layer cover structure, the core being obtained from a rubber composition comprising 100 pbw of a base rubber and 18 to 28 pbw of a metal salt of an unsaturated carboxylic acid, the inner cover having a specific gravity of 1.2 to 1.5, a thickness of 0.5 to 2.0 mm, and a Shore D hardness greater than that of the outer cover but not more than 80, and the outer cover has a specific gravity of 0.5 to 1.2, a thickness of 1.0 to 2.5 mm and a Shore D hardness of 63 to 73. The ball of the invention combines the good spin retention properties of a wound ball with the flight distance and durability of a solid ball.

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Fig. 1



SOLID GOLF BALL

The present invention relates to a golf ball. More particularly, it relates to a golf ball having an excellent shot feel and spin performance, whilst still possessing good flight distance and durability.

In general, there are two types of golf balls. One is a solid golf ball (e.g. a solid two-piece golf ball), which comprises a core formed from vulcanized rubber and a cover formed from a thermoplastic resin (e.g. an ionomer resin) on the core. The other is a thread wound golf ball, which is produced by winding a rubber thread around a solid or liquid center, followed by providing a cover of an ionomer resin or balata having a thickness of from 1 to 2 mm.

Since the solid golf ball has a good durability and faster initial velocity at the time when it is hit in comparison with the thread wound golf ball, it has longer flight distance and a better flight performance. Solid golf balls are therefore very popular with golfers, especially amateur golfers. The solid golf ball suffers, however, from poor shot feel and also in that only a small amount of spin can be applied due to the fast initial velocity at the time of hitting and the small contact area between the golf ball and club. Therefore, spin is not easily applied to the golf ball and the solid golf ball lacks controllability at an approach shot. Professional golfers and upper level golfers who consider shot feel and controllability important do not, consequently, like the solid golf ball.

In order to solve the above problems, it has been suggested that the cover should be soft to give flexibility in order to obtain a shot feel which is similar to that of the thread wound golf ball.

However, in order to obtain a soft feeling solid golf ball, it is necessary that the core is also made soft. The solid golf ball containing a solid core has a poor impact resilience and the flight distance and durability are accordingly deteriorated. The controllability of the golf ball can be ideal during a driver shot because the contact time between the club and the ball is longer and at an approach shot the ball has a high amount of spin. However, when the core is softened, the amount of spin which can be applied is lowered with the result of a deterioration in the controllability.

It is an object of the present invention to address the above problems associated with conventional solid golf balls and to provide a solid golf ball having an excellent shot feel and good spin performance without a deterioration in flight performance and durability, which are special features of the solid golf ball.

This object as well as other objects and advantages of the present invention will be apparent to those skilled in the art from the following description with reference to the accompanying drawing.

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Fig. 1 is a schematic cross section illustrating the golf ball of the present invention.

The present invention provides a solid golf ball comprising a core (1) and a cover formed on the core, the cover having a two-layer cover structure of an inner cover layer (2) and an outer cover layer (3), wherein the core (1) is obtained from a rubber composition comprising 100 parts by weight of a base rubber and 18 to 28 parts by weight of a metal salt of an unsaturated carboxylic acid and the inner cover layer (2) has a specific gravity of 1.2 to 1.5, a thickness of 0.5 to 2.0 mm and a Shore D hardness within the range of more than that of the outer cover layer (3) and not more than 80 and, the outer cover layer (3) has a specific gravity of 0.5 to less than 1.2, a thickness of 1.0 to 2.5 mm and a Shore D hardness of 63 to 73.

In order to carry out the present invention more suitably, it is preferred that the core has a deformation amount formed between an initial load of 10 Kg and a final load of 130 Kg within the range from 4.0 to 6.0 mm.

It is also preferred that the inner cover layer is formed from a mixture of an ionomer resin and a polyamide resin and an amount of the polyamide resin formulated is within the range from 3 to 25% by weight.

It is further preferred that the inner cover layer cover contains high-specific gravity filler, such as tungsten powder.

In the golf ball of the present invention, the two cover layers (2 and 3) are formed on a core (1). The core is obtained by pressure molding a rubber composition at an elevated temperature. The rubber composition comprises a base rubber, a crosslinking agent, a metal salt of an unsaturated carboxylic acid and the like.

The base rubber can be natural and /or synthetic rubbers which have hitherto been used for the solid golf ball. Among them, preferred is a high-cis polybutadiene having a cis-1,4-structure of not less than 40%, preferably not less than 80%, into which natural rubber, polyisoprene rubber, styrene-butadiene rubber, EPDM, etc. may be optionally formulated.

Examples of the crosslinking agent include organic peroxides such as dicumyl peroxide or t-butyl peroxide, and dicumyl peroxide is preferred. An amount of the crosslinking agent formulated may preferably be within the range from 0.3 to 5.0 parts by weight, preferably from 0.5 to 3.0 parts by weight, based on 100 parts by weight of the base rubber.

To the rubber composition used for the production of the solid golf ball of the present invention, a metal salt of an unsaturated carboxylic acid is added in addition to the above materials. Examples of the metal salt of the unsaturated carboxylic acid include monovalent or divalent metal salts of an unsaturated carboxylic acid having 3 to 8 carbon atoms, such as acrylic or methacrylic acid. Among them, zinc acrylate is preferred for imparting high rebound characteristics. An amount of the metal salt of unsaturated carboxylic acid formulated is within the range from 18 to 28 parts by weight based on 100 parts by weight of the base rubber. When

the amount is more than 28 parts by weight, the resultant golf ball is too hard and shot feel is inferior. On the other hand, when the amount is less than 18 parts by weight, rebound characteristics are poor.

The rubber composition may contain additives which have been used for producing the solid core, such as organic sulfide compounds (e.g. polysulfides having 2 to 4 sulfur atoms, for example diphenyl polysulfide, dibenzyl polysulfide, dibenzoyl polysulfide, dibenzothiazoyl polysulfide, dithiobenzoyl polysulfide, etc.) and tetraalkylthiuram sulfide; inert fillers such as zinc oxide, barium sulfate, calcium carbonate, etc.; antioxidants; and the like. An amount of the organic sulfide compound is 0.5 to 2.0 parts by weight, based on 100 parts by weight of the base rubber. An amount of the inert filler is preferably within the range of from 16 to 19 parts by weight, based on 100 parts by weight of the base rubber. An amount of the antioxidant is preferably 0.2 to 0.5 parts by weight, based on 100 parts by weight of the base rubber.

The core can be obtained by molding the above rubber composition with heating using suitable method and condition, which are generally used for the solid core. The core preferably has a diameter of 32 to 37.5 mm. In order to obtain the desired shot feel, the core preferably has a deformation amount formed between an initial load of 10 Kg and a final load of 130 Kg within the range from 4.0 to 6.0 mm. When the deformation amount is less than 4.0 mm, the solid core is too hard. On the other hand, when the deformation amount is more than 6.0 mm, the solid core is too soft. The core may be composed of either one layer or two or more layers.

Then, the core (1) is covered with the inner cover layer (2)

and outer layer cover (3). The cover can be formed from an ionomer resin which has been used as a cover material of the solid golf ball, and specific examples of the ionomer resin include Hi-milan 1557, 1605, 1652, 1705, 1706, 1707, 1855 and 1856 (which are manufactured by Mitsui Du Pont Polychemical Co., Ltd.) and Iotec 7010 and 8000 (which are manufactured by Exxon Co.) but are not limited thereto. Among them, Hi-milan 1706, Iotec 8000 or a combination thereof is preferably used for the inner cover layer (2), and Hi-milan 1652, 1706, 1707 or 1855 or a combination thereof is preferably used for the outer cover layer (3). A small amount of the other resins may also be added.

It is preferred that the inner cover layer (2) is formed from either the above mentioned ionomer resin or a mixture of the ionomer resin and polyamide resin. The mixing ratio of the polyamide resin can be within the range from 0 to 25% by weight, preferably 3 to 25 % by weight. The polyamide resin can be any type of polyamide resins which are commercially available, but nylon 12 is preferred. A hardness of the inner cover layer can be increased by adding the polyamide resin to the inner cover layer. When the mixing ratio of the polyamide resin is more than 25% by weight, the cover is too hard and durability is poor. On the other hand, when the amount is smaller than 3% by weight, the technical effects derived therefrom are small.

The cover composition may contain additives such as inorganic fillers (e.g. zinc oxide, barium sulfate, etc.) and colorants (e.g. titanium dioxide, etc.). High-specific gravity fillers can be added to the inner cover layer for the purpose of adjusting the specific gravity.



Examples of the high-specific gravity filler include metal powder, metal oxide, metal nitride, metal carbonate, etc., for example, tungsten, tungsten carbide, molybdenum, lead, lead oxide, nickel and copper or a mixture thereof. In addition, barium sulfate, titanium dioxide or zinc white whose  
5 specific gravity is comparatively small may be used in place or addition of the high-specific gravity filler and a mixture of these fillers and high-specific filler may also be used.

The inner cover layer has a specific gravity of 1.2 to 1.5, a thickness of 0.5 to 2.0 mm and a Shore D hardness within the range of  
10 more than that of the outer cover layer (3) and not more than 80. When the specific gravity of the inner cover layer is less than 1.2, inertia moment is small and spin is liable to be disappeared (decayed). On the other hand, when the specific gravity is more than 1.5, the amount of the filler is large and it is difficult to conduct molding. When the thickness of the cover is  
15 smaller than 0.5 mm, durability is lowered. On the other hand, when the thickness is more than 2.0 mm, shot feel is hard and poor. When the hardness of the cover is less than the Shore D hardness of the outer cover layer (3), rebound characteristics are deteriorated and flight distance is lowered. On the other hand, when the hardness is more than 80, shot feel  
20 is hard and poor. The Shore D hardness is a hardness measured according to ASTM D-2240.

The outer cover layer has a specific gravity of 0.5 to less than 1.2, a thickness of 1.0 to 2.5 mm and a Shore D hardness of 63 to 73. When the specific gravity of the outer cover layer is 1.2 or more, the ball  
25 weight is too large and it is difficult to obtain a golf ball suitable for the

weight limitation of golf balls. On the other hand, it is difficult to adjust the specific gravity to less than 0.5. When the thickness of the cover is less than 1.0 mm, durability is deteriorated. On the other hand, when the thickness is more than 2.5 mm, rebound characteristics are deteriorated, thereby lowering flight distance. When the cover hardness is less than 63 (Shore D hardness), rebound characteristics are deteriorated, thereby lowering flight distance. On the other hand, when the hardness is more than 73, shot feel is hard and poor.

To the cover layer (inner cover layer (2) and outer cover layer (3)), for example, colorants (e.g. titanium oxide, etc.) and other additives (e.g. ultraviolet absorbers, photostabilizers, fluorescent materials, fluorescent brighteners, etc.) may be formulated within the range at which the desired characteristics due to the golf ball cover are not deteriorated. An amount of the colorant is preferably within the range from 0.1 to 0.5 parts by weight.

The preferred formulations of the inner cover layer (2) and outer cover layer (3) of the present invention are shown below but are not limited thereto.

Kind	(Parts by weight)	
	Inner cover layer	Outer cover layer
Ionomer resin	75 - 100	90 - 100
Polyamide resin	0 - 25	-
High-specific gravity filler	25 - 40	-
Filler	-	0 - 5
Pigment	-	0 - 0.05
Antioxidant	-	0 - 0.5

The cover layer in the present invention is formed by per se known methods which are used for forming the cover of the golf ball, for example, injection molding, press molding, etc. Firstly, the core (1) is covered with inner cover (2), and then the outer cover (3) is covered thereon. When the outer cover (3) is covered, a lot of recesses referred to as dimples are generally formed on the surface. In order to enhance appearance and commercial value, the golf ball of the present invention is generally put on the market after coating with paint.

According to the present invention, there is provided a golf ball having excellent shot feel and spin performance without deteriorating flight performance.

### EXAMPLES

The following Examples and Comparative Examples further illustrate the present invention in detail but are not to be construed to limit the scope thereof.

#### Production of core

The formulations shown in Table 1 were respectively kneaded and then vulcanization-molded to obtain a spherical core having a diameter of 35.1 mm $\phi$ . The vulcanization was conducted in two stages. For example, the vulcanization was conducted at 140°C for 16 minutes, then at 165°C for additional 8 minutes.

Table 1

Kind	(Parts by weight)					
	I	I	III	IV	V	VI
BR-18 (Note 1)	100	100	100	100	100	100
Zinc acrylate	22	19	14	33	22	22
Zinc oxide	17.6	18.7	20.6	13.3	32.2	-
Antioxidant (Note 2)	0.5	0.5	0.5	0.5	0.5	0.5
Dicumyl peroxide	1.6	1.6	1.8	1.4	1.6	1.6
Diphenyl peroxide	0.5	0.5	0.5	0.5	0.5	0.5

Vulcanization condition: 140°C x 16 minutes + 165°C x 8 minutes

(Note 1) High-cis-1,4-polybutadiene, manufactured by Japan Synthetic Rubber Co., Ltd.

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(Note 2) Antioxidant, manufactured by Yoshitomi Pharmaceutical Industries, Ltd.

### Examples 1 to 5 and Comparative Examples 1 to 6

#### (a) Inner cover layer

An inner cover layer was formed by injection-molding the cover formulations A to D shown in Table 2 on the above core. The cover formulation, cover thickness, Shore D hardness and specific gravity of the formed inner cover layer are shown in Table 3.

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#### (b) Outer cover layer

An outer cover layer was formed by injection-molding the cover formulations E to I shown in Table 2 on the above inner cover layer obtained by above (a). The cover formulation, cover thickness, Shore D hardness and specific gravity of the formed outer cover layer are shown in Table 3.

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**Table 2**

Type	A	B	C	D	E	F	G	H	I
Hi-milan (Note 3) #1557	-	-	-	-	-	5	30	-	-
Hi-milan (Note 3) #1605	-	-	-	-	25	20	-	42.5	-
Hi-milan (Note 3) #1652	-	-	-	-	-	-	-	-	30
Hi-milan (Note 3) #1706	50	47.5	25	25	25	-	-	42.5	20
Hi-milan (Note 3) #1707	-	-	-	-	-	-	20	-	20
Hi-milan (Note 3) #1855	-	-	-	-	50	75	50	-	30
Iotec (Note 4) #8000	50	47.5	75	75	-	-	-	-	-
AMNOD (Note 5)	-	5.0	-	-	-	-	-	15.0	-
Tungsten	32.3	31.9	-	81.8	-	-	-	-	-
Titanium oxide	-	-	-	-	0.3	0.3	0.3	0.3	0.3
Barium sulfate	-	-	2.5	-	0.3	0.3	0.3	0.3	0.3
Antioxidant (Note 6)	-	-	-	-	0.03	0.03	0.03	0.03	0.03

(Note 3) Ionomer resin, manufactured by Mitsui Du Pont Polychemical Co., Ltd.

(Note 4) Ionomer resin, manufactured by Exxon Co.

(Note 5) Nylon 12, manufactured by Toray Co., Ltd.

5 (Note 6) Antioxidant, manufactured by Sankyo Co., Ltd.

The flight distance and spin amount due to a driver (No. 1 wood club) as well as spin amount and shot feel due to a sand wedge of the resultant golf balls were evaluated. The results are shown in Table 3. The test methods are as follows.

10 (Test methods)

① Flight distance and spin amount

A driver was fit to a swing robot manufactured by True Temper Co., Ltd. and a golf ball was hit with a head speed of 45 m/second to measure the distance (carry) to the dropping point as the flight distance.

The spin amount was determined by continuously taking photographs of the hit gold ball. According to the same manner as that described above, a sand wedge was fit to a swing robot manufactured by True Temper Co., Ltd. and a golf ball was hit with a head speed of 19.2 m/second to measure the distance (carry) to the dropping point as the flight distance. The spin amount was determined by continuously taking photographs of the hit gold ball.

② Shot feel

A golf ball was practically hit by 10 top professional golfers to evaluate the shot feel. The criteria thereof are as follows.

Evaluation criteria

◎: Excellent

○: Good

△: Ordinary

XH: Poor (too hard)

XS: Poor (too soft)

(Test results)

Table 3

Item	Example					Comparative Example					
	1	2	3	4	5	1	2	3	4	5	6
Core	Formulation	I	I	I	I	III	IV	V	VI	I	I
	Diameter (mm)	35.1	35.1	35.1	35.1	35.1	35.1	35.1	35.1	35.1	35.1
	Compression deformation amount (mm)	4.8	4.8	4.8	5.5	6.3	3.5	4.8	4.8	4.8	4.8
Inner cover	Formulation	A	A	B	A	A	A	C	D	A	A
	Thickness (mm)	1.9	1.9	1.9	1.9	1.9	1.9	1.9	1.9	1.9	1.9
	Shore D-scale hardness	70	70	72	70	70	70	70	70	70	70
	Specific gravity	1.25	1.25	1.25	1.25	1.25	1.25	0.98	1.66	1.25	1.25
Outer cover	Formulation	E	F	E	E	I	E	E	E	G	H
	Thickness (mm)	1.9	1.9	1.9	1.9	1.9	1.9	1.9	1.9	1.9	1.9
	Shore D-scale hardness	66	63	66	66	64	66	66	66	59	73
	Specific gravity	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98
Ball physical properties	Driver Carry (yard)	210.9	209.3	210.2	208.7	209.8	205.4	200.6	206.9	207.2	205.6
	Spin (rpm)	2650	2710	2610	2560	2680	2420	2780	2790	2730	2820
	Sandwedge Spin (rpm)	5690	5800	5720	5840	5760	5880	5790	5670	5610	5920
	Feeling	O	O	△	⊙	O	XS	XII	O	O	XII

As is apparent from the above results, the core is softened and the hardness of the cover is reduced as shown in Table 3 so as to improve the shot feel and controllability at the time of hitting in Examples 1 to 5 of the present invention, and the golf balls of Examples 1 to 5 are superior in shot feel and controllability at the time of hitting as well as flight performance.



CLAIMS:

1. A solid golf ball comprising a core (1) and  
a cover formed on the core, the cover having a two-  
5 layer cover structure of an inner cover layer (2) and  
an outer cover layer (3), wherein the core (1) is  
obtained from a rubber composition comprising 100  
parts by weight of a base rubber and from 18 to 28  
parts by weight of a metal salt of an unsaturated  
10 carboxylic acid and the inner cover layer (2) has a  
specific gravity of from 1.2 to 1.5, a thickness of  
from 0.5 to 2.0 mm and a Shore D hardness of more than  
that of the outer cover layer (3), but not more than  
80, and the outer cover layer (3) has a specific  
15 gravity of from 0.5 to less than 1.2, a thickness of  
from 1.0 to 2.5 mm and a Shore D hardness of from 63  
to 73.

2. A solid golf ball according to claim 1,  
20 wherein the core has a deformation amount, formed  
between an initial load of 10 kg and a final load of  
130 kg, within the range of from 4.0 to 6.0 mm.

3. A solid golf ball according to claim 1 or  
25 claim 2, wherein the inner cover layer is formed from  
an ionomer resin.

4. A solid golf ball according to any one of  
claims 1 to 3, wherein the inner cover layer (2) is  
30 formed from a mixture of an ionomer resin and a  
polyamide resin and an amount of the polyamide resin  
formulated is within the range of from 3 to 25% by  
weight.

35 5. A solid golf ball according to claim 3 or

claim 4, wherein the inner cover layer (2) further comprises a high-specific gravity filler.

5           6.    A solid golf ball substantially as herein described with reference to any one of Examples 1 to 5.

10           7.    A solid golf ball substantially as herein described with reference to Figure 1 of the accompanying drawing.

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Application No: GB 9620946.5  
Claims searched: 1 to 7

Examiner: Alan Blunt  
Date of search: 9 January 1997

**Patents Act 1977**  
**Search Report under Section 17**

**Databases searched:**

UK Patent Office collections, including GB, EP, WO & US patent specifications, in:

UK Cl (Ed.O): A6D

Int Cl (Ed.6): A63B 37/00

Other:

**Documents considered to be relevant:**

Category	Identity of document and relevant passage	Relevant to claims
A	EP0661082A1 (SUMITOMO)	1

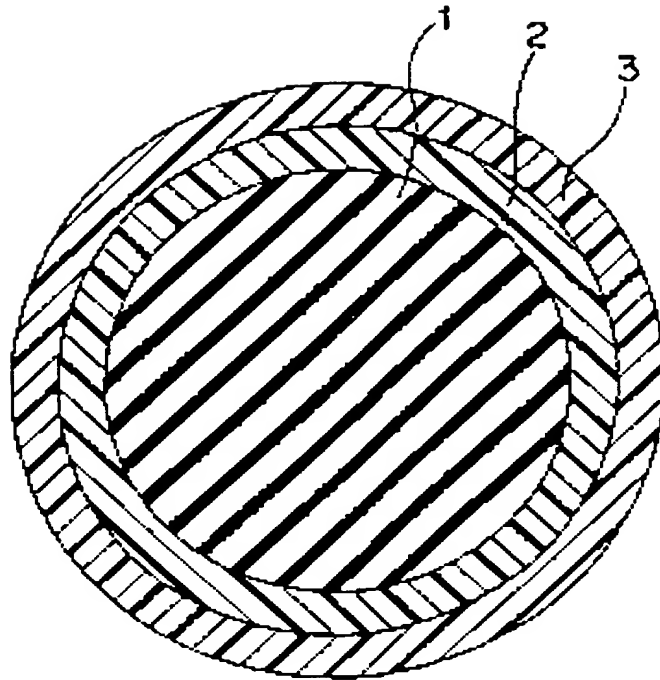
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P Document published on or after the declared priority date but before the filing date of this invention.  
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Fig. 1



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